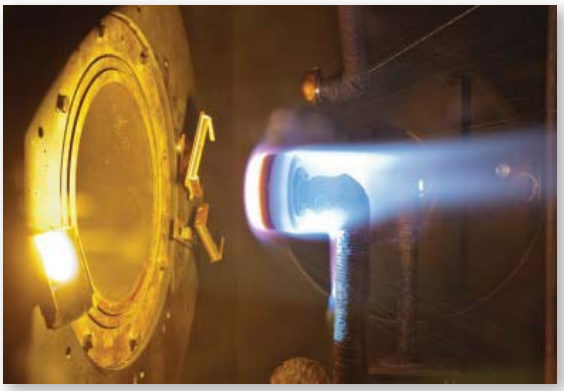
A New Ablative Heat Shield Sensor Suite Project

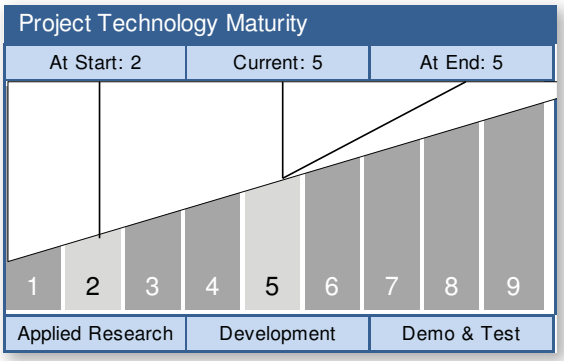
Center Innovation Fund: ARC CIF Program

Office Of The Chief Technologist (OCT)

National Aeronautics and Space Administration



Arc Jet Testing of the Sensor



ABSTRACT

A new sensor suite is developed to measure performance of ablative thermal protection systems used in planetary entry vehicles for robotic and human exploration. The new sensor suite measures ablation of the thermal protection system under extreme heating encountered during planetary entry. The sensor technology is compatible with a variety of thermal protection materials, and is applicable over a wide range of entry conditions.

Technology Area: Entry, Descent & Landing Systems TA09 (Primary)

ANTICIPATED BENEFITS

To NASA funded missions:

- Provides a means to acquire flight data for thermal protection system design of planetary entry vehicles
- Provides a means to acquire flight data to enable use of existing systems in more extreme environments with minimal risk
- Provides vehicle performance data (mass loss) during entry for atmosphere structure investigation (relevant for outer planets)

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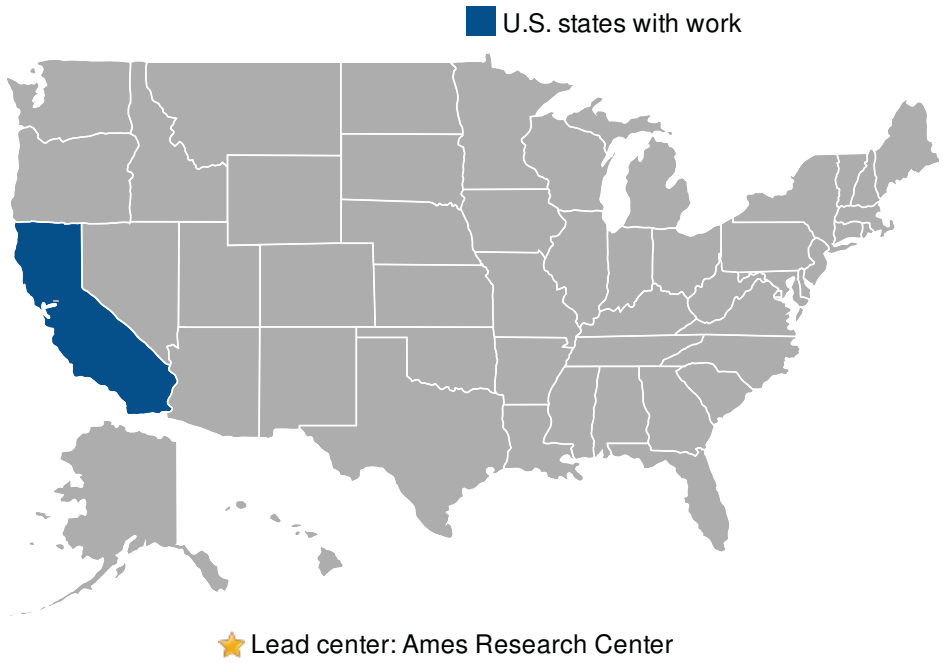
Read more on the last page.



MANAGEMENT

Project Manager:
Deepak Bose

Principal Investigator:
Deepak Bose

Co-Investigators:
Joseph Mach
Tomomi Oishi

DETAILED DESCRIPTION

The project has developed a reliable sensor that measures recession of an ablative thermal protection system used by a planetary entry vehicle. The sensor prototype has been built and tested in an arc jet facility in a flight relevant environment. The sensor suite includes optical sensors that sense existence of ultraviolet emission from high temperature gases in front of the vehicle. As the surface of the thermal protection system recedes, it progressively exposes each sensor and provides timed locations of the moving ablation front. The sensor data does not rely on elaborate data analysis procedure which simplifies interpretation. The sensor suite can also be integrated in a sensor plug that can be readily embedded in a variety of thermal protection materials using proven installation procedures.

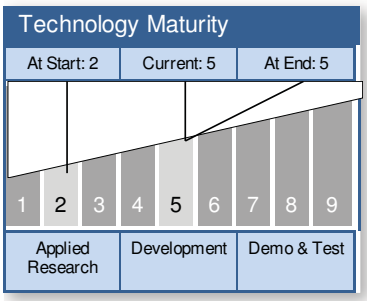
Using data from the sensor, it is envisioned that the design of entry systems will significantly improve by reducing mass of the thermal protection system. The thermal protection system accounts for 5-50% of the entry vehicle mass, depending on the mission, which could be traded for increased efficiency and performance. It is also likely that existing entry vehicle architectures (build-to-print systems) would realize benefits by pushing the flight envelope to more extreme conditions based on flight data acquired by this sensor ...

DETAILED DESCRIPTION (CONT'D)

suite.

TECHNOLOGY DETAILS

A New Ablative Heat Shield Sensor Suite



TECHNOLOGY DESCRIPTION

The technology is a sensor suite that will help acquire critical engineering data of thermal protection system performance during planetary entries. The technology is versatile for use in low and moderate heating entries (Mars and Earth entry from LEO) as well as high heating entries (Outer Planets, Venus, Earth Return).

This technology is categorized as a hardware component or part for unmanned spaceflight

- Technology Area
  - TA09 Entry, Descent & Landing Systems (Primary)

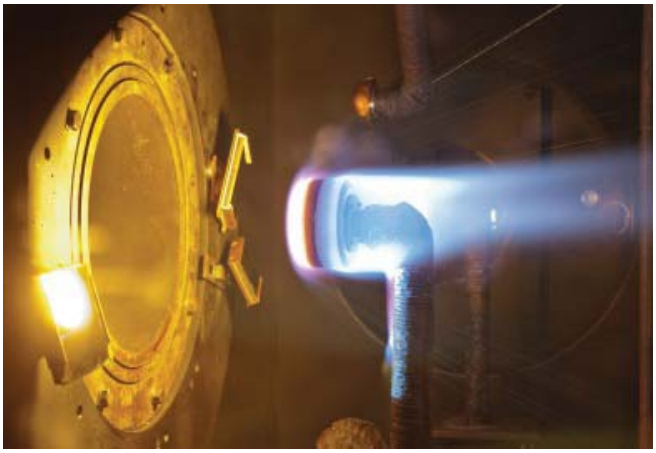
CAPABILITIES PROVIDED

The technology provides a unique capability where ablation and in-depth response of thermal protection systems on planetary entry vehicles can be acquired. The data will provide unprecedented view into the performance of a vehicle subsystem that accounts for about 5-50% of vehicle mass depending on the mission.

The technology is versatile for use in low and moderate heating entries (Mars and Earth entry from LEO), as well as high heating entries (Outer Planets, Venus, Earth Return). The sensor can be used to provide design and performance data during planetary entry, as well as vehicle mass loss data which can be used for atmosphere structure investigation.

Performance Metrics		
Metric	Unit	Quantity
recession measurement accuracy	mm	0.5

IMAGE GALLERY



Arc Jet Testing of the Sensor

ANTICIPATED BENEFITS

To NASA unfunded & planned missions: (CONT'D)

The technology can be used for several planetary entry missions including, but not limited to, Earth entries, Sample Return missions, and Mars, Venus, and Outer Planet entries.

To other government agencies:

The technology will have benefits for any entry missions that use ablative thermal protection systems including the ones undertaken by the Department of Defense.

To the commercial space industry:

As commercial space industry develops advanced spaceflight hardware, it will benefit from technologies such as this sensor suite in order to develop systems for more extreme return trajectories, and explore other planets.

To the nation:

The technology provides tools to advance entry systems for private space industry, NASA, and the DoD.